IN THE FOOTSTEPS OF VON HUMBOLDT DISCOVERING CENTRAL LIGURIA GEOLOGY

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ABSTRACT

Alexander von Humboldt (1769 – 1859) was a versatile scholar, who had a holistic approach to nature: he could be defined an explorer of the natural world.
Among his interests, geology played an important role. Humboldt visited Liguria twice, aiming at studying the rocks, and in particular the outcrops of central Liguria which, at the beginning of the 19th century, were along the only vehicular road connecting Genova with the Po plain. Here he observed many different and contrasting lithologies, either of ophiolitic or carbonatic nature, and gave proof of his great analytical and synthesis skills. The geologic area he visited, known in literature as the "Sestri-Voltaggio Zone", has long been the object of scientific debate because it has been considered a possible limit between the Alps and the Apennines.

KEYWORDS: Sestri-Voltaggio Zone; ophycarbonate rocks; limestone

INTRODUCTION

Alexander von Humboldt (1769 – 1859) was a versatile scholar, who had a holistic approach to nature (Wulf, 2017 and references cited). One might say that he was even more interested in the connections among different disciplines than in the single details but nonetheless he has been rigorous in his scientific research. Geology was therefore just one of his many interests, but probably mountains, together with volcanoes, were among the natural elements that he loved most, starting with the Andes, the Urals and finally the Himalaya, that he yearned to see for all his live, unfortunately without success.

After all, since he studied as a mining engineer at Freiberg University, in Germany, geology was part of his background since the beginning of his career.

He was also interested in what we now call "plate tectonics" and already in 1807 Humboldt stated that Africa and South America were once united, even if the plate tectonics theory, which explains how and why this actually happened, consolidated only around the middle of the XXth century (about 150 years later).

According to literature, Humboldt visited Central Liguria twice, in 1795 and 1805 (Wulf, 2017). My presentation during this congress relies almost totally on the results of a study day entitled «Humboldt alla Bocchetta» that was held in June, 2004 in Lerma (AL); it was jointly organized by the then Dip.Te.Ris (Dipartimento per lo Studio del Territorio e delle Sue Risorse dell'Università di Genova) and the Natural Park of Capanne di Marcarolo, to analyse the Humboldt's travel notebooks.

The study day has been followed by an excursion that was meant to retrace the 1805 journey, trying to find the described places (in between Campomorone and Voltaggio, in the Genova hinterland) and to check Humboldt's observations. The excursion was led by Prof.

Cortesogno, then Full Professor of Petrography in the Dip.Te.Ris and leading expert of geology of this area (see, for instance, Cortesogno & Haccard, 1984 and Cortesogno et al., 1979).

In the following we will retrace Humboldt's journey, breafly outlining the geological features of Central Liguria and, in particular, of the so-called "Sestri-Voltaggio Zone".

RESULTS AND DISCUSSION

The Sestri – Voltaggio Zone (Sacco, 1887; Rovereto, 1939; Cortesogno & Haccard, 1984; for a comprehensive reference list on this topic please see Capponi & Crispini, 2008 and Molli et al., 2011) is made up of different rock formations aligned along an almost north-south direction (Fig. 1). These rocks belong to different tectono-metamorphic units, since they are different kinds of rocks put in contact as a consequence of deformation events. This area is interesting because it encompasses many different lithologies in a short distance and moreover it has been historically considered the limit between two orogenic belts: the Alps and the Apennines (Cortesogno et al., 1979; Cortesogno & Haccard, 1984; Hoogerdujn Strating, 1991).

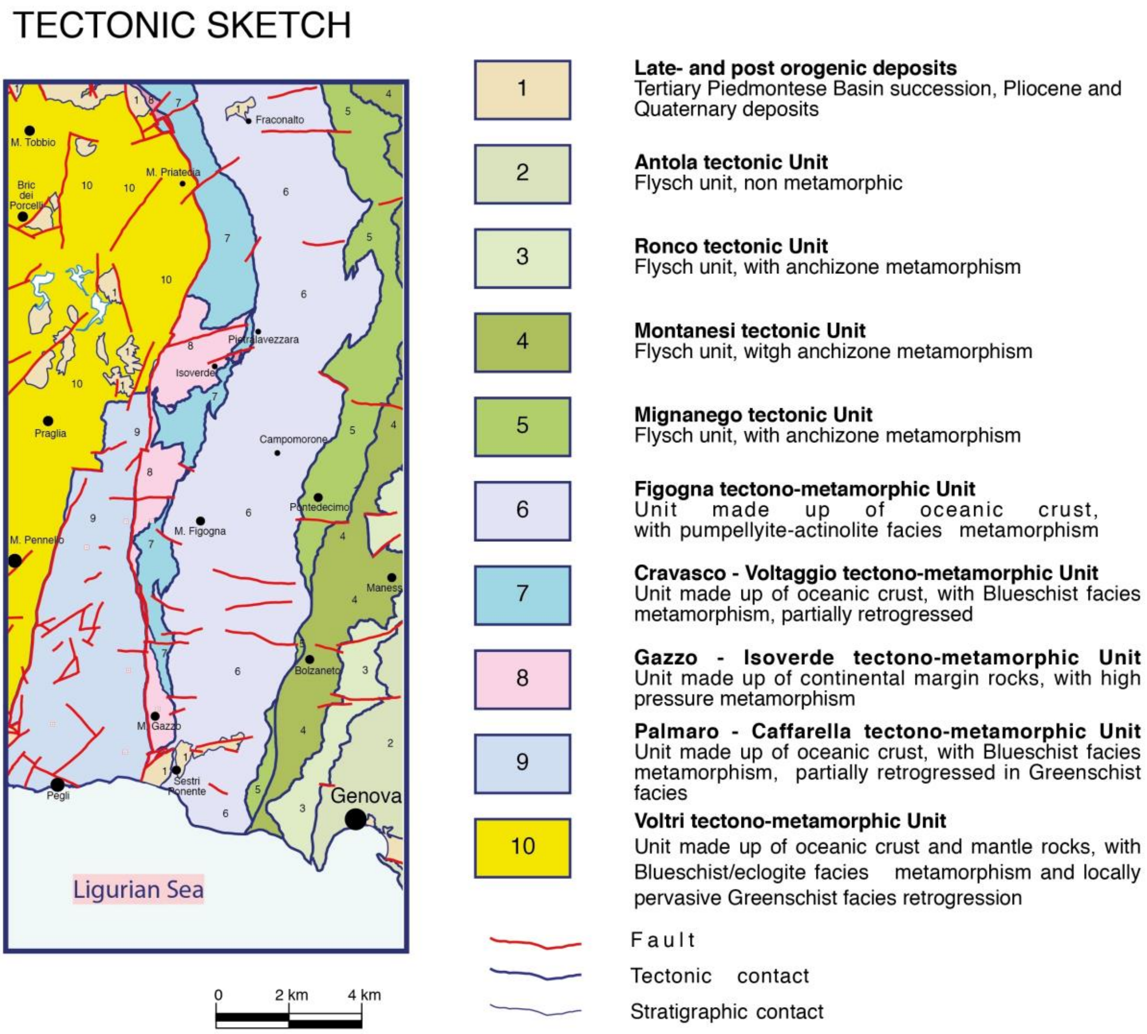

Figure 1. Tectonic sketch of the Sestri-Voltaggio Zone (comprising the Gazzo – Isoverde, Cravasco – Voltaggio and Figogna Units) and of the adjacent units (modified from Capponi & Crispini, 2008).

The tectono-metamorphic units are:

i) the Gazzo – Isoverde Unit (Triassic – Liassic Unit *Auct.*; Cortesogno & Haccard, 1984), which is made up of dolostone, chalk, limestone and mudstone now metamorphosed in blueschist facies (Capponi & Crispini, 2008); this metamorphism takes place at high pressure conditions, that typically occur when a plate is dragged ("subducted") below another plate;

ii) the Cravasco – Voltaggio Unit, which is made up of an ophiolitic succession i.e. crystalline rocks (serpentinite. gabbro, basalt) and sedimentary rocks (chert, mudstone and shale), again metamorphosed in blueschist facies (Capponi & Crispini, 2008);

iii) the Figogna Unit, again made up of ophiolites, and therefore with almost the same original lithologies as the Cravasco-Voltaggio Unit, but with a different metamorphic overprint, in Prehnite – Pumpellyite facies (Desmons et al., 1999).

As cited before, rocks of these units formed in different environments. In detail, the Gazzo – Isoverde Unit encompasses sedimentary rocks formed on a continental shelf, (i.e. a relatively flat or gently tilted area between the coastline and the slope, where steepness markedly increases, and that connects the shelf to the ocean floor). The two other units, on the contrary, are made up of rocks formed at a divergent margin (where the plates move away from each other), at a mid-oceanic ridge.

Humboldt did not see all the lithologies of these units, but most likely the Gazzo-Isoverde Unit metalimestone, the Figogna Unit serpentinite and ophycalcite and the Cravasco – Voltaggio Unit metalimestone. Now let's follow his itinerary in some detail.

The first stop was likely around the village of Isoverde (Fig. 2) even if he only writes "after Campomorone": we make this hypothesis because he cites a geometric attitude of limestone strata that in this unit we only find in this area (Cortesogno & Haccard, 1984). Here Humboldt describes limestone interbedded with marl and shale horizons that are richer and richer up in the succession from the Middle Triassic (about 240 Ma BP) to the Rhetyan (about 200 Ma BP) and Lower Jurassic (up to about 180 Ma BP).

The transition from limestone, typical of a platform sedimentary environment, to shale, typical of abyssal plain environment (deep ocean floor), is accomplished here by means of an increase in the frequency of shale horizons. Humboldt noted this progressive change, and described it as "transitional limestone".

Subsequently Humboldt reached Pietralavezzara (Fig. 2), where he describes ophicarbonate rocks, which were already quarried and known with the commercial name of "Verde Polcevera". These rocks are actually breccias (i.e. rocks formed by fragments of other rocks) made up of serpentinite fragments cemented by calcite. This mix creates a pleasant colour contrast that makes them suited to architectural use. Humboldt must have also observed serpentinite and basalt, but sometimes confusing one for the other.

The trip goes on to the Bocchetta Pass: the route crossing the Bocchetta Pass has actually been the only viable one between Genova and the Po Plain until 1824. Here Humboldt describes limestone with shale intercalations (that he names "Calcari della Bocchetta") that actually belong to the metaophiolitic sequence of the Cravasco-Voltaggio Unit. He describes these rocks as "calcaire feuilletès", because he observes small-scale planar discontinuities, which are actually of tectonic origin, i.e. not primary, but due to deformations subsequent to their formation.

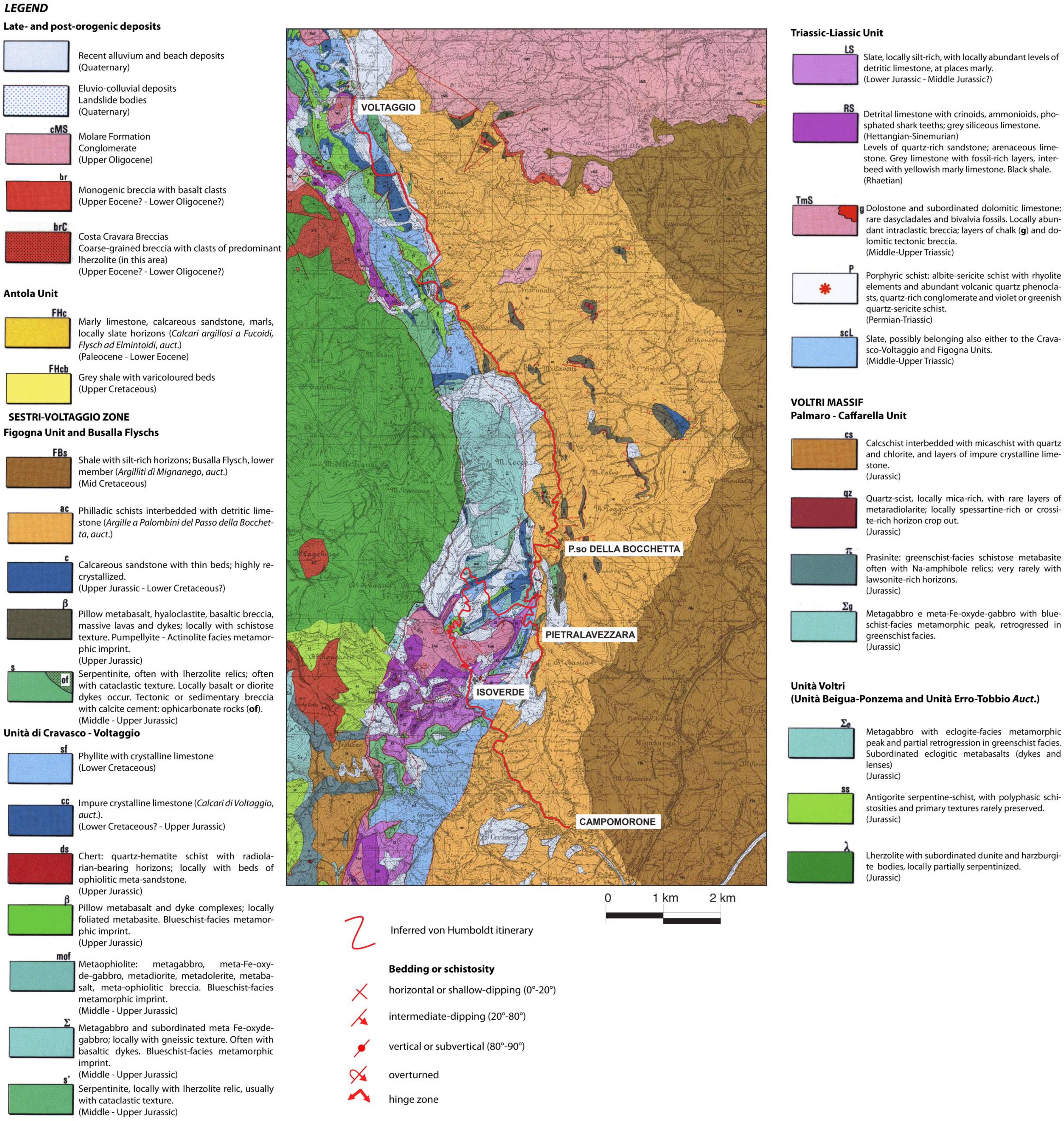

Figure 2. Geological Map of the area object of Humboldt's itinerary (central-northern part of the Sestri-Voltaggio Zone) (extracted and modified from Cortesogno & Haccard, 1984). The red line is the Humboldt's supposed itinerary.

Humboldt's journey likely went on to Voltaggio; during his route Humboldt described this limestone again; he wrote that they are interbedded with serpentinite, whereas they are actually other rocks of the ophiolitic sequence.

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